DOCUMENT RESUME

ED 208 874 IR 009 788

AUTHOR Lema-Stern, Sandra
TITLE Children's Visual Attention: Effects of Color, Complexity, Movement and Incongruity.
PUB DATE 5 Sep 80
NOTE 13p.; Paper presented at the Annual Meeting of the American Psychological Association (Montreal, Canada, September 5, 1980).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Attention Span; *Child Development; *Computer Graphics; Elementary Education; Factor Analysis; Models; Visual Discrimination; Visual Literacy; *Visual Stimuli; Young Children

ABSTRACT

Four-, six- and eight-year-old children from an Evanston, Illinois school were the subjects for three experiments designed to evaluate the effects of color, complexity, movement, and incongruity on children's visual attention. Computer generated displays were used to: (1) assess developmental trends among the three age groups, (2) test a novel methodology which allowed for the experimental manipulation of all relevant variables, and (3) evaluate the effects of all variables using the common dependent measure of relative viewing time. The meaning-process model, which predicts that attention should increase as a function of increasing information conflict or complexity, served as the framework for examining the results of the experiments. It was found that color and form complexity increased viewing time, that only form complexity interacted with age, and that movement and form incongruity increased attention. Five references are listed and four figures are appended. (Author/MER)

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Children's Visual Attention: Effects of Color, Complexity, Movement and Incongruity

Sandra Lema-Stern
Barat College
Lake Forest, Illinois

American Psychological Association Convention
Montreal
September 5, 1980

IR009788

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ABSTRACT

Studies in voluntary visual attention and children's television viewing behavior have suggested several important parameters of children's visual attention. Three experiments used computer-generated displays to investigate the effects of color, complexity, movement, and incongruity on viewing time of four-, six-, and eight-year old children. Results showed: 1) color and form complexity increased viewing time; 2) only form complexity interacted with age; 3) movement increased attention, but the effect did not increase with amount of movement; 4) form incongruity increased attention. Results are discussed with respect to the meaning-processing model of visual attention, dimensional salience, and implications for children's television programming.

CHILDREN'S VISUAL ATTENTION: EFFECTS OF COLOR, COMPLEXITY, MOVEMENT AND INCONGRUITY

To what does a child visually attend? Studies in voluntary visual attention and children's television viewing behavior suggest that children may be more attentive to stimuli which possess activity (Anderson and Levin, 1976), movement (Flagg, Allen, Geer, and Scinto, 1976), and complexity and incongruity (Nunnally and Lemond, 1973; Nunnally, Lemond and Wilson, 1977). Also, the saliency of some of these stimulus characteristics may vary developmentally. For instance, Odom and Guzman (1972) found that color decreased in dimensional salience for older children while complexity (number of elements) increased. The present series of experiments evaluates the effects of color, complexity, movement, and incongruity on children's visual attention. Specifically, the major objectives are: 1) to assess developmental trends by using three age groups in each experiment; 2) to test a novel methodology utilizing computer generated displays which allow the experimental manipulation of all relevant variables; and 3) to evaluate the effects of all variables using a common dependent measure--relative viewing time.

Methods (common to all experiments)

The subjects were four- (N=14), six- (N=16), and eight- (N=16) year old children from an Evanston, Illinois school. Subjects were tested individually in sessions lasting approximately 30 minutes. A Compucolor II microcomputer generated stimulus displays on a 33 cm (diagonal) color CRT display screen. During each 10 second trial, the screen contained two stimulus displays, placed side by side for pairwise comparison. A wedge, centered at the division between the two stimulus displays, required the child to make a head movement in order to switch his or her view from one side to the other (see Fig. 1). Head movements and displays were monitored and recorded with a video camera and recorder. Thus, the child's

This research was conducted at Northwestern University as part of the author's dissertation and was supported by National Institutes of Health grant EY00956.

visual attention could be measured as relative viewing times. Data for each subject on each display was then subjected to the appropriate repeated measures ANOVA. Reliability of the scoring procedures was checked by having three judges score the videotape data on four randomly chosen subjects. The average inter-judge correlation was .98.

Experiment I

Two levels of form complexity (number of elements) and three levels of color complexity (number of colors) were factorially combined. The stimuli were checkerboards consisting of either a 4 x 4 grid or a 12 x 12 grid. Size of the grid was constant. There were 2, 4, or 8 colors present within the grids. Results indicated that increasing either form or color complexity significantly increased viewing time. The overall relative mean viewing times, for the 2-, 4-, and 8-color conditions were 46.0%, 50.7%, and 53.3% respectively. The overall mean for the 4 x 4 grid condition was 46.4% while it was 53.6% for the 12 x 12 grid. The analysis also revealed a form complexity by age interaction: the effect was present only for the two older age groups, and the effect increased with age (see Fig. 2).

Experiment II

A 3 x 2 factorial experiment examined the roles of movement and color in visual attention. Movement was defined as the number of moving elements (0, 1, or 3) in a display. In addition, the relative viewing times for color and black-and-white displays were examined. Each stimulus display consisted of three geometric forms which were programmed to move independently and in random directions within certain areas of the screen. Analysis revealed a significant effect for both movement and color. The conditions with 0, 1, or 3 moving elements yielded overall relative mean viewing times of 37.1%, 55.8%, and 57.1%. In other words, displays containing one moving element increased viewing time by almost 20% over displays with no movement.

Three moving elements, however, were no more effective than one in holding children's attention (see Fig. 3). The overall relative mean for the black-and-white condition was 42.2% while it was 57.8% for the color condition, indicating 15% greater attention to color displays. These effects were consistent across age groups.

Experiment III

Three types of incongruity were investigated in this experiment: 1) form incongruity was defined as an object with an unusual orientation (e.g. an upside down house); 2) color incongruity consisted of an object with an unusual color (e.g. a purple tree); and 3) movement incongruity existed when an usually stationary object moved (e.g. a moving mailbox). Hence, programmed stimulus displays contained easily recognizable scenes of two common objects. The data in Figure 4 (analyzed with the Newman-Keuls Test) show that form incongruity was effective in eliciting longer viewing times. Color incongruity was not significant, but the sample means were in the direction of increased viewing time. Incongruous movement was no more effective than congruous movement (e.g. a moving car).

Discussion

Results are discussed with respect to the meaning-processing model of visual attention (Nunnally and Lemond, 1973; Nunnally, Lemond, and Wilson, 1977) which predicts that attention should increase as a function of increasing information conflict (incongruity) or complexity. While this model can explain many of the results, its accuracy depends on which stimulus dimensions and which age groups are being considered. For instance, increasing form complexity increased attention, but only for the two older age groups. Since age groups have different saliency hierarchies (Odom and Guzman, 1972), the model may need to be modified to include such developmental trends.

The results also have implications for the research on and development of children's television programming. For example, while movement, a crucial component of

programming, was possibly the most effective variable studied, it is movement, per se, and not the number of moving elements or incongruous movement that increased attention.

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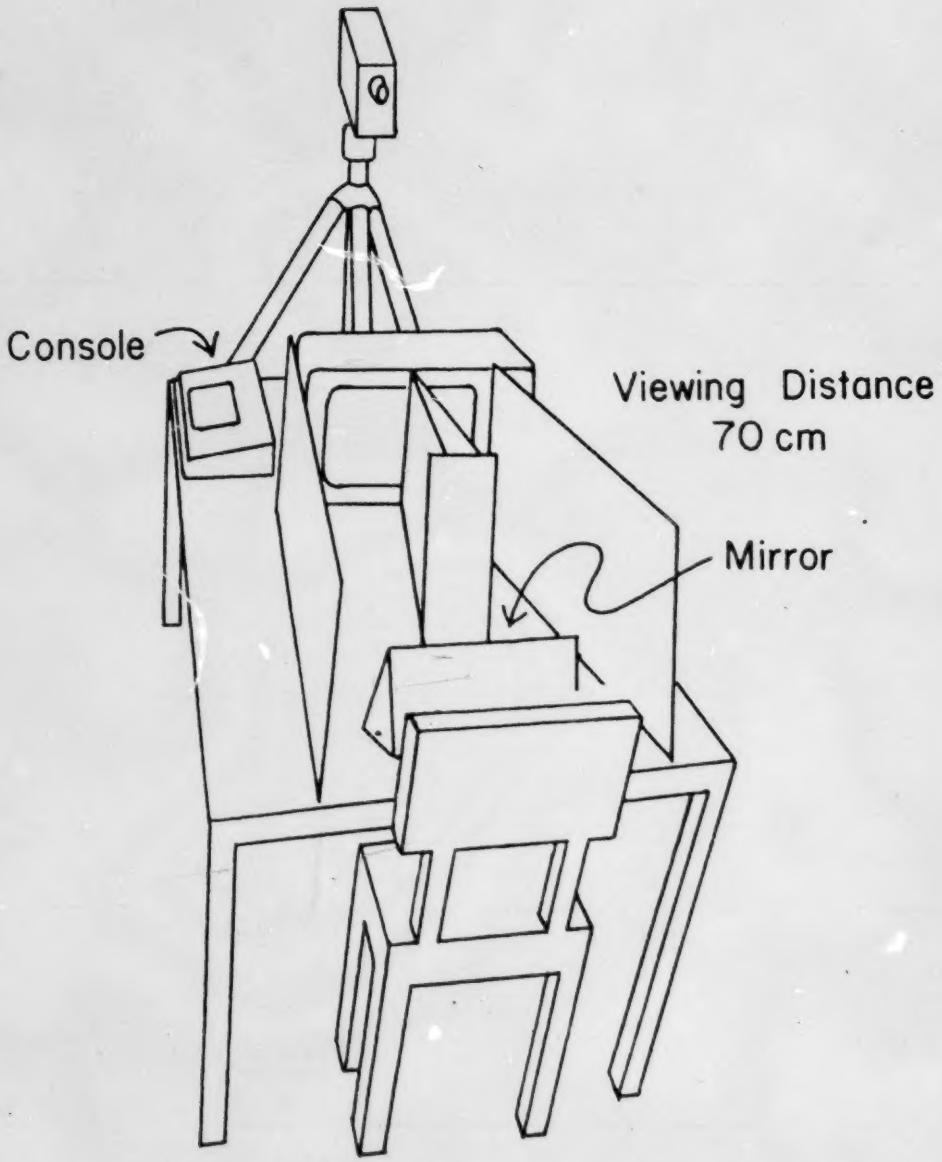

Figure 1. Schematic drawing of the apparatus used in all three experiments.

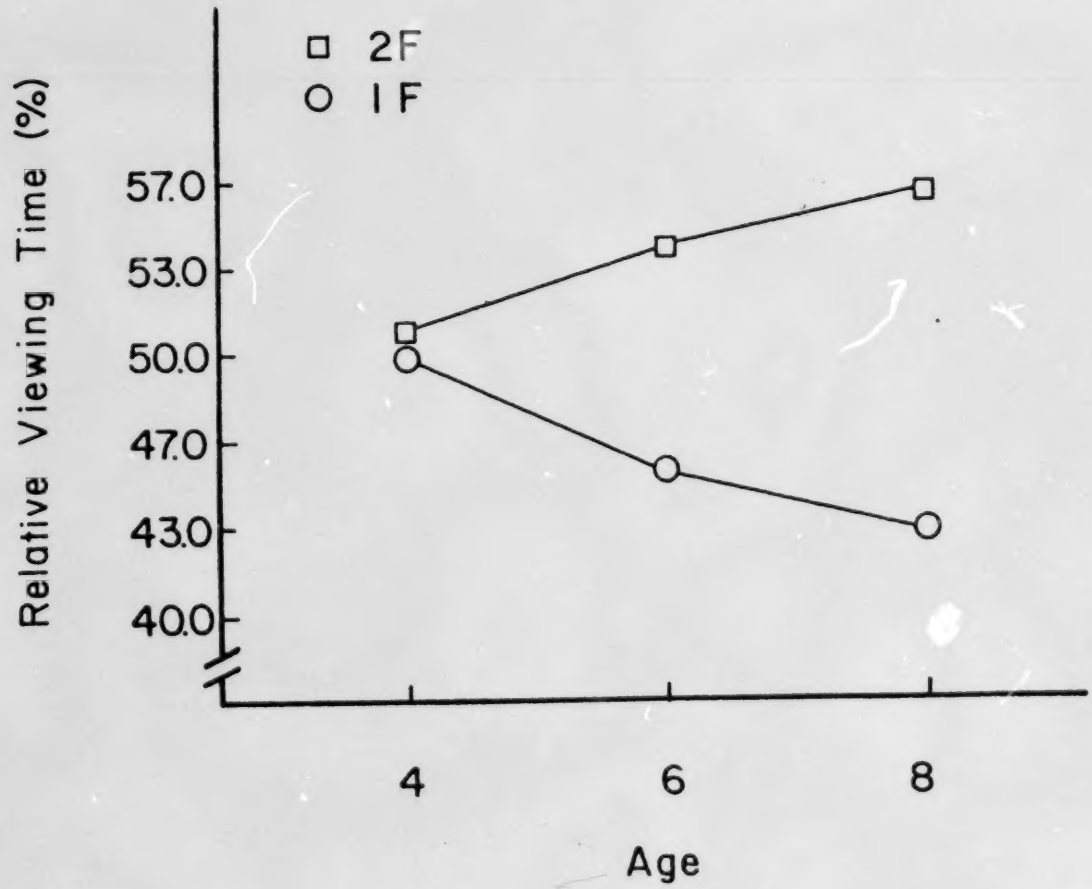

Figure 2. Mean relative viewing times for the form complexity conditions for the three age groups. The 1F displays contained 16 elements (4 x 4 checkerboard) and the 2F displays contained 144 elements (12 x 12).

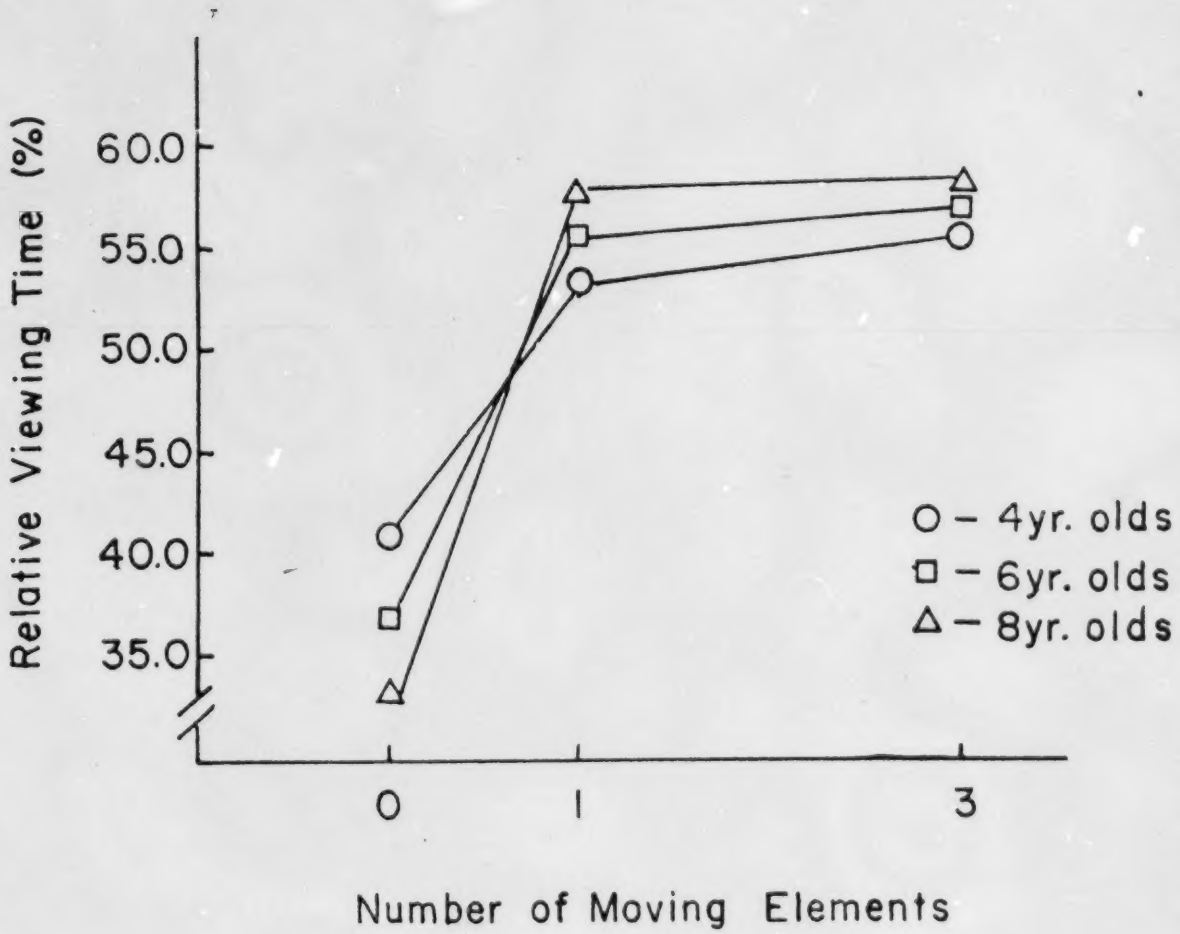

Figure 3. Mean relative viewing times for the movement conditions for each of the three age groups.

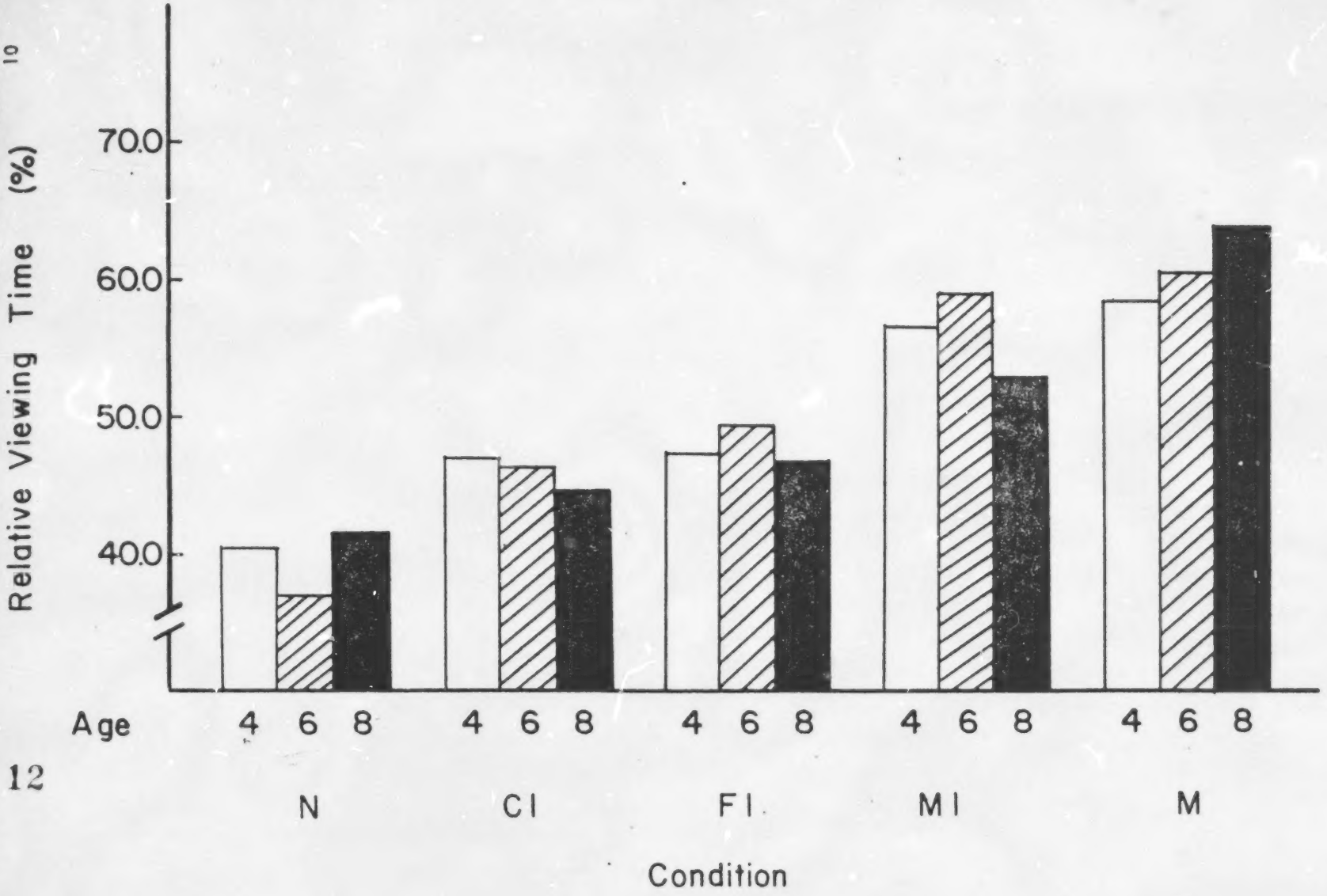

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Figure 4. Mean relative viewing times for each age group in control (N), color incongruity (CI), form incongruity (FI), movement incongruity (MI), and congruous movement (M) conditions.